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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART  
EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS  
EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

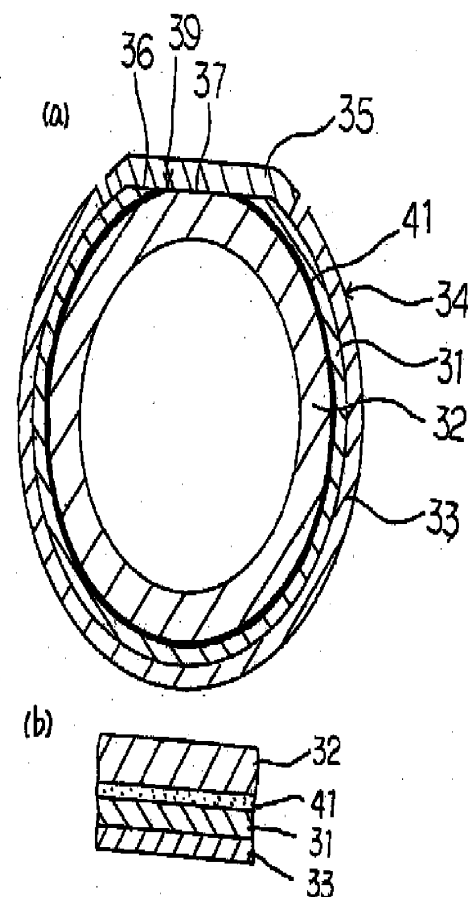
[0001]

[Field of the Invention]This invention relates to the solid oxide fuel cell cell which laminates a solid electrolyte and a fuel electrode one by one on the surface of an air pole, and its process.

[0002]

[Description of the Prior Art]Before, since the operating temperature is 900-1050 \*\* and an elevated temperature, generation efficiency of a solid oxide fuel cell is high, and it is expected as a power generation system of the third generation.

[0003]Generally cylindrical and a monotonous type are known by the solid oxide fuel cell cell. Although a monotonous type fuel cell cell has the feature that power density is high, per unit volume of power generation, about utilization, there are problems, such as gas-seal imperfection and the heterogeneity of the temperature distribution in a cell. To it, by a cylindrical fuel cell cell, although power density is low, there is the feature that the

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mechanical strength of a cell is high and the homogeneity of the temperature in a cell can be maintained. Taking advantage of each feature in a dimorphism-like solid oxide fuel cell cell, research and development are furthered positively.

[0004]the single cell of a cylindrical fuel cell is shown in drawing 2 -- as -- the  $\text{LaMnO}_3$  system of about 30 to 40% of the rate of an open pore -- the porous air pole hanger tube 2 which consists of materials, [ form and ] The solid electrolyte 3 which becomes that surface from  $\text{Y}_2\text{O}_3$  stabilization  $\text{ZrO}_2$  is covered, and the fuel electrode 4 of porous nickel-zirconia is further formed in this surface, and it is constituted.

[0005]In the module of a fuel cell, each single cell is connected via the charge collector (interconnector) 5 of a  $\text{LaCrO}_3$  system. The air (oxygen) 6 is passed to air pole hanger tube 2 inside, it pours the fuel (hydrogen) 7 outside, and power generation is performed at the temperature of 1000-1050 \*\*.

[0006]As a method of manufacturing the above fuel cell cells, The end of insulating powder it consists of  $\text{CaO}$  stabilization  $\text{ZrO}_2$  cylindrical by an extrusion method etc. For example, after shaping, Calcinate this, produce a cylindrical substrate and to the peripheral face of this base material An air pole, Applying the slurry of a solid electrolyte, a fuel electrode, and a charge collector, calcinating this one by one, and laminating it, or forming an air pole, a solid electrolyte, a fuel electrode, and a charge collector one by one by electrochemical vacuum deposition (the EVD method), a plasma spray process, etc. on the surface of a cylindrical substrate is also performed.

[0007]In recent years, in order to simplify the manufacturing process of a cell and to reduce a manufacturing cost, what is called a co-sintering method that carries out simultaneous calcination of at least two of each components is proposed. This co-sintering method is the method of twisting a solid electrolyte Plastic solid and a charge collector Plastic solid around a cylindrical air pole Plastic solid at rolled form, for example, performing simultaneous calcination, and forming a fuel electrode layer in the solid electrolyte layer surface after that. For process simplification, a fuel electrode Plastic solid is further laminated on the surface of a solid electrolyte Plastic solid, and the co-sintering method which carries out simultaneous calcination is also proposed.

[0008]This co-sintering method also has few manufacturing process numbers in a very easy process, and is advantageous to the improvement in the yield at the time of manufacture of a cell, and cost reduction. In the fuel cell cell by such a co-sintering method. For making a coefficient of thermal expansion agree in this solid electrolyte using the solid electrolyte which

consists of  $\text{Y}_2\text{O}_3$  stabilization or partial stabilization  $\text{ZrO}_2$  etc., What replaced some La of the perovskite type multiple oxide which consists of  $\text{LaMnO}_3$  by Y and Ca as an air pole material is used (references, such as JP, H10-162847,A).

[0009]

[Problem(s) to be Solved by the Invention]However, if a cylindrical fuel cell cell is produced using the co-sintering method mentioned above, Mn element which is a constituent of an air pole will be spread in solid phase toward the inside of a fuel electrode via a solid electrolyte in the case of co-sintering. As a result, the amount of Mn in a fuel electrode increased, the polarization value of a fuel electrode site and the real resistance of the cell constitution ingredient became high, and, as a result, there was a problem that the power density in the first stage was low.

[0010]The purpose of this invention is as follows.

High power density can be obtained in the first stage.

Provide the solid oxide fuel cell cell which continues at a long period of time and can maintain high power density, and its process.

[0011]

[Means for Solving the Problem]A solid oxide fuel cell cell of this invention on the surface of an air pole which consists of a perovskite type multiple oxide which contains La and Mn at least. In a solid oxide fuel cell cell which laminates a solid electrolyte which uses  $\text{ZrO}_2$  as the main ingredients, and a fuel electrode one by one and by which said air pole and said solid electrolyte were sintered simultaneously, Between said solid electrolyte and said air pole, a diffusion prevention layer which consists of an oxide containing Y, Zr, and Ce is formed.

[0012]Since a diffusion prevention layer which consists of an oxide containing Y, Zr, and Ce was formed between a solid electrolyte and an air pole in such a solid oxide fuel cell cell, From an air pole, can intercept or control Mn which it is going to diffuse in a fuel electrode by a diffusion prevention layer via a solid electrolyte, can decrease, and a Mn content in a fuel electrode by this, While being able to make low a polarization value of a fuel electrode site, and real resistance of a cell constitution ingredient and being able to make power density high, it continues at a long period of time, and high power density can be maintained.

[0013]When there are many amounts of Mn which exist in a fuel electrode, this, Promote the degree of sintering of a fuel electrode superfluously, and grain growth of metal particles in a fuel electrode becomes superfluous, It is because a touch area of metal particles and a solid electrolyte falls and a polarization value of a fuel electrode site becomes large, and is because Mn

deposits between metal particles further, so conductivity falls and real resistance of a cell constitution ingredient becomes high.

[0014]On the other hand, even if it forms the above-mentioned diffusion prevention layer by  $\text{ZrO}_2$  in which  $\text{CeO}_2$  in which Zr, Y, and Sm dissolved,

for example or Ce, Y, and Sm dissolved, or those mixtures, can control diffusion of Mn, but. It is easy to generate interfacial peeling between a diffusion prevention layer and a solid electrolyte layer, and there is a tendency for a manufacturing yield of a cell to fall as a result. When producing a cylindrical fuel cell cell (it may be called a long cell) 50 cm or more in length, it is easy to produce especially this tendency.

[0015]When this used for a starting material  $\text{CeO}_2$  (it may be called SDC.)

in which Sm dissolved and a diffusion prevention layer was formed, it was because a coefficient of thermal expansion in a pyrosphere of a diffusion prevention layer becomes higher than a solid electrolyte and an air pole which are other cell constitution members.

[0016]So, in this invention,  $\text{CeO}_2$  (it may be called YDC) which dissolved Y is used as a starting material, without using Sm, Since  $\text{ZrO}_2$  in which  $\text{CeO}_2$  in which Zr and Y dissolved or Ce, and Y dissolved, or a diffusion prevention layer which comprises those mixtures was formed, A coefficient of thermal expansion of a diffusion prevention layer can be close brought by a cell constitution member, interfacial peeling of a diffusion prevention layer, and a solid electrolyte and an air pole can be controlled, and a manufacturing yield of a cell can be improved.

[0017]furthermore -- making Y dissolve altogether in  $\text{CeO}_2$  or  $\text{ZrO}_2$  by using YDC -- \*\*\*\* -- things are made, a deposit of a  $\text{Y}_2\text{O}_3$  phase with a low coefficient of thermal expansion can also be prevented in a diffusion prevention layer, as a result, a local unsealed part is lost, and exfoliation can be prevented.

[0018]It is desirable for the amount of Mn in a fuel electrode to be 0.2 or less % of the weight in a solid oxide fuel cell cell of this invention. By doing in this way, a polarization value of a fuel electrode site and real resistance of a cell constitution ingredient can be made still lower.

[0019]It is desirable for a solid electrolyte to be  $\text{ZrO}_2$  containing  $\text{Y}_2\text{O}_3$  in a solid oxide fuel cell cell of this invention. As for a diffusion prevention layer, it is desirable that they are  $\text{CeO}_2$  in which Y and Zr dissolved,  $\text{ZrO}_2$  in which Y and Ce dissolved, or those mixtures, and its things are [ dissolving Zr and Y in  $\text{CeO}_2$  especially ] desirable.

[0020]A process of a solid oxide fuel cell cell of this invention,  $\text{ZrO}_2$  to which Y dissolved on the surface of an air pole Plastic solid which contains

La and Mn at least, And after applying a paste containing  $\text{CeO}_2$  in which Y dissolved and forming a coating film, it is the method of laminating a solid electrolyte Plastic solid and a fuel electrode Plastic solid containing  $\text{ZrO}_2$  on the surface of this coating film one by one, forming a laminate-molding object in it, and calcinating this laminate-molding object.

[0021]For example, when simultaneous calcination of the cell is carried out using a cylindrical air pole material which consists of La, Ca, and a perovskite type multiple oxide containing Y and Mn, also in each constituent element which constitutes an air pole at the time of co-sintering, diffusion (evaporation and diffusion within solid phase) of Mn element divides, and it is quick. That is, it is going to spread Mn in an air pole Plastic solid in a fuel electrode Plastic solid via a solid electrolyte Plastic solid during calcination from an air pole Plastic solid.

[0022]So, in this invention on the surface of an air pole Plastic solid (concept also including a temporary-quenching object). By laminating a solid electrolyte Plastic solid (concept also including a temporary-quenching object) and a fuel electrode Plastic solid one by one, and calcinating them, after applying a paste containing  $\text{ZrO}_2$  in which Y dissolved, and  $\text{CeO}_2$  in which Y dissolved, Between a solid electrolyte and an air pole,  $\text{CeO}_2$  in which Y and Zr dissolved,  $\text{ZrO}_2$  in which Y and Ce dissolved, or a diffusion prevention layer which consists of those mixtures is formed. By this diffusion prevention layer, Mn which it is going to diffuse in a fuel electrode Plastic solid via a solid electrolyte Plastic solid from an air pole Plastic solid can be intercepted or controlled, and a diffusing capacity of Mn in a solid electrolyte and a fuel electrode can be decreased. As a paste, Y may be added as  $\text{Y}_2\text{O}_3$ , without dissolving to  $\text{ZrO}_2$  or  $\text{CeO}_2$ .

[0023]

[Embodiment of the Invention]The air pole 32 is formed in the inner surface of the cylindrical solid electrolyte 31, the solid oxide fuel cell of this invention forms the fuel electrode 33 outside, as shown in drawing 1, the cell body 34 is formed, and the charge collector (interconnector) 35 is electrically connected to the air pole 32.

[0024]Namely, a part of air pole 32 which the notch 36 is formed in some solid electrolytes 31, and is formed in the inner surface of the solid electrolyte 31 is exposed, This exposed surface 37 and the surface of the about 36-notch solid electrolyte 31 are covered with the charge collector 35, and the charge collector 35 is joined to the surface of the air pole 32 exposed from the both-ends surface of the solid electrolyte 31, and the notch 36 of the solid electrolyte 31.

[0025]The charge collector 35 electrically connected with the air pole 32 is

formed in the outside surface of the cell body 34, it is formed so that the continuous same surface 39 which does not have a level difference mostly may be covered, and the fuel electrode 33 is not electrically connected.

[0026]When this charge collector 35 connects between cells, it is electrically connected to the fuel electrode of other cells via nickel felt, and thereby, a fuel cell module is constituted. The continuous same surface 39 is formed by [ which the both ends of the solid electrolyte 31 and a part of air pole 32 followed ] grinding between the both ends of the solid electrolyte 31 until it becomes the same side mostly.

[0027]As for the solid electrolyte 31, 3-15-mol% of the partial stabilization or stabilization  $\text{ZrO}_2$  of which  $\text{Y}_2\text{O}_3$  content was done is used, for example.

As the air pole 32,  $\text{LaMnO}_3$  which did 5-20 atom % substitution of La by 10-30atom% and Y with Ca or Sr is used, for example, and  $\text{LaCrO}_3$  which did 10-30 atom % substitution of Cr with Mg is used as the charge collector 35, for example.

[0028]As the fuel electrode 33, the  $\text{ZrO}_2$  ( $\text{Y}_2\text{O}_3$  content) cermet which contains nickel 50 to 80% of the weight is used. As the solid electrolyte 31, the charge collector 35, and the fuel electrode 33, it is not limited to the above-mentioned example and publicly known material may be used. What is necessary is just to consist of a perovskite type multiple oxide which contains La and Mn at least as the air pole 32.

[0029]And in the solid oxide fuel cell of this invention, the Mn diffusion prevention layer 41 which consists of an oxide containing Y, Zr, and Ce is formed between the solid electrolyte 31 and the air pole 32. As for this Mn diffusion prevention layer 41, it is desirable that they are  $\text{CeO}_2$  in which Y and Zr dissolved,  $\text{ZrO}_2$  in which Y and Ce dissolved, or those mixtures, and its things are [ dissolving Zr and Y in  $\text{CeO}_2$  especially ] desirable.

[0030]As for the diffusion prevention layer 41, it is desirable to express an empirical formula with  $1-z\{(\text{CeO}_2)_{1-x}(\text{Y}_2\text{O}_3)_x\} - z\{(\text{ZrO}_2)_{1-y}(\text{Y}_2\text{O}_3)_y\}$ , and to satisfy  $0.2 \leq x \leq 0.4$ ,  $0.05 \leq y \leq 0.08$ , and  $0.03 \leq z \leq 0.3$ .

[0031]It is because there is a tendency for x to become higher than the cell constitution member of others [ value / of a diffusion prevention layer / coefficient-of-thermal-expansion ] in being less than 20-mol %, and there is a tendency for  $\text{Y}_2\text{O}_3$  to be able to dissolve to neither  $\text{CeO}_2$  nor  $\text{ZrO}_2$ , and to deposit as  $\text{Y}_2\text{O}_3$  when more than 40-mol %.

[0032]The coefficient-of-thermal-expansion value of a diffusion prevention layer can be brought close to other cell constitution members by making y into 5-8-mol %. It is because the effect which there is a tendency for z to cause the mismatch of thermal expansion with a cell constitution member

like the above in being less than 3 % of the weight, and  $\text{ZrO}_2$  which is easy to diffuse Mn when more than 30 % of the weight will increase, and controls Mn diffusion becomes small.

[0033]In the diffusion prevention layer 41, Ca as an air pole ingredient and Y may be further contained by diffusion, and, as for the thickness, 2-15 micrometers is desirable from the point of consistency of the coefficient of thermal expansion between members.

[0034]The amount of Mn in the fuel electrode 33 is made into 0.2 or less % of the weight. Thus, by making the amount of Mn in the fuel electrode 33 into 0.2 or less % of the weight, the polarization value of a fuel electrode site and the real resistance of a cell constitution ingredient can be made still lower.

[0035]This invention is used suitably [ the effective length (the length of the portion which the air pole, the solid electrolyte, and the fuel electrode superimpose) which contributes to power generation ] for a solid oxide fuel cell cell of 40 cm or more.

[0036]The process of the solid oxide fuel cell cell constituted as mentioned above forms a cylindrical air pole Plastic solid first. this cylindrical air pole Plastic solid follows a predetermined preparation presentation, for example -- raw material of  $\text{La}_2\text{O}_3$ ,  $\text{Y}_2\text{O}_3$ ,  $\text{CaCO}_3$ , and  $\text{Mn}_2\text{O}_3$  -- weighing -- it mixes.

[0037]Then, for example, temporary quenching is carried out at the temperature of about 1500 \*\* for 2 to 10 hours, and grinding preparation is carried out after that at the particle size of 4-8 micrometers. A binder is mixed and kneaded to the prepared granular material, a cylindrical air pole Plastic solid is produced by an extrusion method, debinding processing is carried out further and a cylindrical air pole temporary-quenching object is produced by performing temporary quenching at 1200-1250 \*\*. Since diffusion of Mn is remarkable above 1400 \*\*, at the temporary-quenching temperature of the above-mentioned air pole Plastic solid, Mn is hardly diffused.

[0038]For example,  $\text{Y}_2\text{O}_3$  and  $\text{ZrO}_2$  powder of CaO in which a kind dissolved at least, An empirical formula carries out mixed temporary quenching of the  $\text{CeO}_2$  powder in which Y expressed with  $1(\text{CeO}_2)\text{-x}(\text{Y}_2\text{O}_3)$  x dissolved, Toluene was added as a solvent to the powder mixture which carried out particle size preparation after that, the paste was produced, this paste was applied to the surface of a cylindrical air pole temporary-quenching object, and the coating film of the diffusion prevention layer 41 was formed. Although  $\text{Y}_2\text{O}_3$  may exist during a paste, it is desirable to dissolve altogether in  $\text{CeO}_2$  after sintering.

[0039]What added and slurred toluene, the binder, and the commercial

dispersing agent to predetermined powder as the sheet shaped 1st solid electrolyte Plastic solid by methods, such as a doctor blade. For example, temporary quenching of the 1st solid electrolyte Plastic solid is stuck and carried out to the surface of the coating film of the diffusion prevention layer 41 formed in the surface of a cylindrical air pole temporary-quenching object using what was fabricated in thickness of 100-120 micrometers, and the 1st solid electrolyte temporary-quenching object is formed in the surface of an air pole temporary-quenching object. Although temporary quenching of the 1st solid electrolyte Plastic solid was carried out, it is not necessary to carry out temporary quenching.

[0040]Next, a sheet shaped fuel electrode Plastic solid is produced. First, for example, what added and slurred toluene and a binder to the nickel/YSZ mixed powder prepared to the predetermined ratio is prepared. Like production of said 1st solid electrolyte Plastic solid, it fabricates and dries, for example, the sheet shaped 15-micrometer-thick 2nd solid electrolyte Plastic solid is formed.

[0041]After printing a fuel electrode layer Plastic solid and drying on this 2nd solid electrolyte Plastic solid, the 2nd solid electrolyte Plastic solid in which the fuel electrode layer Plastic solid was formed on the 1st solid electrolyte temporary-quenching object is twisted so that the 2nd solid electrolyte Plastic solid may contact the 1st solid electrolyte temporary-quenching object, and is laminated.

[0042]Next, the charge collector Plastic solid fabricated in thickness of 100-120 micrometers is stuck on a prescribed spot like preparation of a solid electrolyte Plastic solid.

[0043]Then, the layered product of a cylindrical air pole temporary-quenching object, the coating film of the diffusion prevention layer 41, the 1st solid electrolyte temporary-quenching object, the 2nd solid electrolyte Plastic solid, a fuel electrode Plastic solid, and a charge collector Plastic solid is 1400-1550 °C in temperature among the atmosphere, and is co-burned simultaneously four layers, for example.

[0044]Since diffusion of Mn also influences calcination temperature and retention time, it can decrease the amount of Mn further by reducing calcination temperature as much as possible, and shortening firing time as much as possible.

[0045]The paste which contains  $ZrO_2$  in which Y dissolved, and  $CeO_2$  in which Y dissolved in such a process, After applying to the surface of a cylindrical air pole temporary-quenching object, forming the coating film of the diffusion prevention layer 41 and laminating a solid electrolyte Plastic solid and a fuel electrode Plastic solid one by one, by carrying out simultaneous calcination, Between a solid electrolyte and an air pole, the diffusion prevention layer 41 containing Y, Zr, and Ce is formed, by this



diffusion prevention layer 41, diffusion of Mn from an air pole to a solid electrolyte can be controlled, and the diffusing capacity of Mn in a fuel electrode can be decreased.

[0046] Since a solid electrolyte layer,  $\text{ZrO}_2$  which dissolved Y of the presentation, and YDC with the coefficient-of-thermal-expansion value near a cell constitution member are beforehand used for the diffusion prevention layer 41 of this invention, it can prevent breakage of the cell under manufacture, and the breakage produced by temperature-up cooling under power generation.

[0047] In a cylindrical solid oxide fuel cell cell, the structure is not an air pole and a thing which it is alike on the other hand, and the fuel electrode should just be formed, and is limited to drawing 1 at one side of a solid electrolyte.

[0048] Although the above-mentioned example explained the example in which the air pole temporary-quenching object and the 1st solid electrolyte temporary-quenching object were formed, these may be an air pole Plastic solid and the 1st solid electrolyte Plastic solid.

[0049]

[Example] In order to produce a cylindrical solid oxide fuel cell cell with a co-sintering method, the cylindrical air pole temporary-quenching object was first produced in the following procedures.  $\text{La}_2\text{O}_3$  of not less than 99.9% of commercial purity,  $\text{Y}_2\text{O}_3$ ,  $\text{CaCO}_3$ , and  $\text{Mn}_2\text{O}_3$  are used as a starting material, Temporary quenching was carried out at 1500 \*\*,  $(\text{La}_{0.56}\text{Y}_{0.14}\text{Ca}_{0.3})_{0.97}\text{MnO}_3$  was produced, after that, grinding adjustment was carried out, deby \*\* temporary quenching made it the particle size of 5 micrometers on 1250 \*\* conditions after extrusion molding using this, and the air pole temporary-quenching object was produced.

[0050] Next, the slurry was prepared using the  $\text{ZrO}_2$  powder whose mean particle diameter which contains  $\text{Y}_2\text{O}_3$  at 8-mol% of a rate is 1-2 micrometers, and the sheet as the 1st and 2 solid-electrolyte Plastic solid (100 micrometers in thickness and 15 micrometers in thickness) was produced with the doctor blade method.

[0051] Next, production of a fuel electrode Plastic solid is explained. The  $\text{ZrO}_2$  powder which contains  $\text{Y}_2\text{O}_3$  whose mean particle diameter is 0.6 micrometer at 8-mol% of a rate was prepared to the Ni powder whose mean particle diameter is 0.4 micrometer, it prepared so that a nickel/YSZ ratio (weight fraction) might be 65/35, and it slurred by performing a grinding mixing process.

[0052] Then, on the 2nd solid electrolyte Plastic solid, the prepared slurry

was printed on the whole surface so that it might become a thickness of 30 micrometers.

[0053]Next,  $\text{La}_2\text{O}_3$  of not less than 99.9% of commercial purity,  $\text{Cr}_2\text{O}_3$ , and  $\text{MgO}$  are used as a starting material, After carrying out weighing mixing of this so that it may become the presentation of  $\text{La}(\text{Mg}_{0.3}\text{Cr}_{0.7})_{0.97}\text{O}_3$ ,

temporary-quenching grinding was carried out at 1500 \*\* for 3 hours, the slurry was prepared using this solid solution powder, and the 100-micrometer-thick charge collector Plastic solid was produced with the doctor blade method.

[0054]At [ the  $\text{ZrO}_2$  powder (YSZ) containing  $\text{Y}_2\text{O}_3$  and when it expresses empirical formula  $(\text{CeO}_2)_{1-x}(\text{Y}_2\text{O}_3)_x$  ]. x mixed the powder of the value shown in Table 1 in proportion shown in Table 1, added toluene as a solvent to this powder mixture, and produced the paste of the diffusion prevention layer. No.9 of Table 1 --  $\text{Y}_2\text{O}_3$ 5-mol % -- using the  $\text{ZrO}_2$  powder to contain -- other samples --  $\text{Y}_2\text{O}_3$ 8-mol % -- the  $\text{ZrO}_2$  powder to contain was used.

[0055]First, the paste of the diffusion prevention layer was applied, it twisted around rolled form and temporary quenching was carried out to said air pole temporary-quenching object on the conditions of 5 hours at 1150 \*\* so that those both ends might carry out the opening of said 1st solid electrolyte Plastic solid to this coating film. After temporary quenching, it was processed so that the same field that ground evenly and continued between the both ends of the 1st solid electrolyte temporary-quenching object so that an air pole temporary-quenching object might be exposed might be formed.

[0056]Next, the 2nd solid electrolyte Plastic solid in which the fuel electrode Plastic solid was formed in the 1st solid electrolyte temporary-quenching body surface, After having laminated so that the 1st solid electrolyte temporary-quenching object and the 2nd solid electrolyte Plastic solid might contact, and drying, the charge collector Plastic solid was stuck on the above-mentioned continuous same surface, it calcinated on the conditions of 3 hours at 1550 \*\* among the atmosphere after this, and the co-sintering object was produced.

[0057]as a comparison sample --  $\text{Y}_2\text{O}_3$ 8-mol % -- the paste which mixed the SDC powder of the 0.8 ( $\text{CeO}_2$ ) ( $\text{Sm}_2\text{O}_3$ ) 0.2 presentation 80% of the weight 20% of the weight, and produced the  $\text{ZrO}_2$  powder to contain was applied to the air pole temporary-quenching object, and the co-sintering object was produced like the above.

[0058]Next, the sample which evaluates Mn diffusing capacity inside a fuel electrode was produced using the above-mentioned co-sintering object.

First, in the inside of the fuel electrode of the section of the sample started in length of about 10 mm, a fixed quantity of all the constituents was performed using the electron probe microanalyser (EPMA). Next, the content concentration to all the fuel electrode ingredients of Mn ingredient was computed. The result is shown in Table 1 as an amount of Mn in a fuel electrode.

[0059]Next, in order to produce a cylindrical cell with a length [ for power generation ] of 50 cm (effective electrode 40 cm in length), the sealing member was joined to said co-sintering object one end part. Junction of the sealing member was performed in the following procedures.

[0060]Water was added to the  $\text{ZrO}_2$  powder whose mean particle diameter which contains  $\text{Y}_2\text{O}_3$  at 8-mol% of a rate is 1 micrometer as a solvent, the slurry was prepared, and the one end part of said co-sintering object was immersed in this slurry, and it applied to the one end part peripheral face, and dried so that it might be set to 100 micrometers in thickness. The Plastic solid which has the cap shape as a sealing member cut by performing hydrostatic molding (rubber press) using the powder of said slurry presentation and the presentation. Then, said co-sintering object one end part which covered said slurry was inserted in the Plastic solid for sealing members, and calcination was performed at the temperature of 1300 \*\* among the atmosphere for 1 hour.

[0061]After producing 50 cells which have each diffusion prevention layer, respectively and trying the above-mentioned one end closure junction, the number of the cell which produced interfacial peeling was investigated and it was shown in Table 1 as a peeling rate. Interfacial peeling was observed visually.

[0062]Using the sample started and processed, at 1000 \*\*, air was passed inside the cell and power generation passed hydrogen outside so that effective electrode length might be set to 2.5 cm from a long cell, and it carried out measurement evaluation of each performance with the initial value at the time of an output value being stabilized, and the value after 1000-hour maintenance. It combines with the result of the above-mentioned amount of Mn, and a peeling rate, and these measurement results are shown in Table 1.

[0063]When the air pole was dissolved with chloride and x line diffractometry of the diffusion prevention layer was performed about the sample of this invention, the diffusion prevention layer containing Y, Zr, and Ce was formed, and  $\text{CeO}_2$  in which Y and Zr dissolved was a subject. x line diffractometry result of sample No.4 is shown in drawing 3.

[0064]

[Table 1]

試料 No.	ZrO <sub>2</sub>		CeO <sub>2</sub>			燃料極中 のMn量 wt%	剥離率 %	出力密度 (W/cm <sup>2</sup> )	
	固溶種	含有量 wt%	固溶種	X	含有量 wt%			初期値	1000hr後
*1	Y <sub>2</sub> O <sub>3</sub>	20	Sm <sub>2</sub> O <sub>3</sub>	0.2	80	0.072	67	0.407	0.352
2	Y <sub>2</sub> O <sub>3</sub>	10	Y <sub>2</sub> O <sub>3</sub>	0.2	90	0.006以下	0	0.411	0.418
3	Y <sub>2</sub> O <sub>3</sub>	20	Y <sub>2</sub> O <sub>3</sub>	0.2	80	0.006以下	0	0.421	0.419
4	Y <sub>2</sub> O <sub>3</sub>	10	Y <sub>2</sub> O <sub>3</sub>	0.3	90	0.006以下	0	0.404	0.401
5	Y <sub>2</sub> O <sub>3</sub>	20	Y <sub>2</sub> O <sub>3</sub>	0.3	80	0.006以下	0	0.412	0.419
6	Y <sub>2</sub> O <sub>3</sub>	30	Y <sub>2</sub> O <sub>3</sub>	0.3	70	0.006以下	0	0.407	0.402
7	Y <sub>2</sub> O <sub>3</sub>	10	Y <sub>2</sub> O <sub>3</sub>	0.35	90	0.006以下	0	0.401	0.409
8	Y <sub>2</sub> O <sub>3</sub>	20	Y <sub>2</sub> O <sub>3</sub>	0.35	80	0.006以下	0	0.414	0.411
9	Y <sub>2</sub> O <sub>3</sub>	10	Y <sub>2</sub> O <sub>3</sub>	0.4	90	0.006以下	0	0.402	0.411
*10	Y <sub>2</sub> O <sub>3</sub>	100	—	—	—	0.427	0	0.323	0.291

\*印は、本発明の範囲外の試料を示す。

[0065] From this table 1, in the sample of the solid oxide fuel cell cell of this invention. Since there is no yield fall accompanying interfacial peeling as a long cell and each amount of Mn in a fuel electrode has become 0.2 or less % of the weight, it exceeds 0.4 W/cm<sup>2</sup> from the first stage, and it turns out that after 1000-hour progress has mostly stable power density.

[0066] On the other hand, in No.1 of a comparison sample, to cell production numbers, since the yield by poor exfoliation is low, it turns out that increase of the polarization value accompanying interfacial peeling is advancing temporally, and has led to degradation of performance. In sample No.10, many amounts of Mn in a fuel electrode are understood that the power density in the first stage is low.

[0067]

[Effect of the Invention] As explained in full detail above, in the solid oxide fuel cell cell of this invention. Since the diffusion prevention layer which consists of an oxide containing Y, Zr, and Ce was formed between the solid electrolyte and the air pole, From an air pole, can intercept or control Mn which it is going to diffuse in a fuel electrode by a diffusion prevention layer via a solid electrolyte, can decrease, and the Mn content in a fuel electrode by this, While being able to make low the polarization value of a fuel electrode site, and the real resistance of a cell constitution ingredient and being able to make power density high, it continues at a long period of time, and high power density can be maintained.

[0068] The coefficient of thermal expansion of a diffusion prevention layer can be close brought by a cell constitution member, interfacial peeling of a diffusion prevention layer, and a solid electrolyte and an air pole can be controlled, and the manufacturing yield of a cell can be improved.

[Translation done.]